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16. ABSTRACT

Volatilization of pesticides from treated agricultural crops constitutes a major input of these chemicals into the atmosphere. Microencapsulated pesticide formulations are designed for slow release of biocides and thus increase the residence time on the plant foliage. The rate of volatilization for these formulations should also be substantially less than that from non-encapsulated forms. Methyl parathion was applied to a field in both microencapsulated and emulsifiable concentrate forms. Air samples were taken on the downwind side of the field with a sampler which employs a composite filter designed to trap both particulate and vapor forms of organophosphorus pesticides. Air was sampled beginning 1 hr. after spraying and during intervals for 9 days after application of the insecticide. The physical form of the formulation applied to the plants had a profound effect on the levels of airborne pesticides found near the field.

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Volatilization of Methyl Parathion from Fields Treated With Microencapsulated and Emulsifiable Concentrate Formulations

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The use of organophosphorus pesticides has increased since the cancellation of many persistent organochlorine pesticides for many agricultural uses. Since these pesticides have only limited persistence, more than one application is often required in order to control the same pests. The additional applications result in higher cost and greater consumption of the pesticide. In order to provide additional persistence, some pesticides are now offered in a formulation in which the active ingredient is encapsulated and can be slowly released after application. Since the major pathway of pesticides into the atmosphere is through vaporization (LEE 1976), slow-release pesticide formulations should result in lower airborne levels of the pesticides in the air near treated fields than those in the air near fields treated by conventional means.

The intent of this study was to compare the rate of vaporization of a pesticide applied in a microencapsulated (ENCAP) form to plant foliage with that applied in a conventional emulsifiable concentrate (EC) form.

At the outset of this study, LEIDY et al. (1977), Pesticide Residue Research Laboratory, North Carolina State University, Raleigh, were planning an experiment to determine the persistence of methyl parathion in tobacco plants treated with either the EC or the ENCAP formulations. They allowed us to sample the air near two of their plots. The plots sampled were sprayed at the rate of 1 lb/A (1.12 kg/ha) with either the EC or the ENCAP formulations.

MATERIALS AND METHODS

A sampler designed expecially for organophosphorus pesticides (LISSICK and BOSIN 1975) by Environmental Research Corporation (ERCO)[1] was used to monitor the

[1] Mention of the trade names does not imply endorsement by the U. S. Environmental Protection Agency

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air near the treated plots. This sampler is compact (46x20x33-cm), has a rainhood for all weather operation, and is powered by a standard vacuum cleaner motor.

In operation the sampler requires two filter pads (called "Vapofils" by ERCO). Each filter pad consists of a mixture of Porapak® R and glass fibers sandwiched between two glass fiber filter surfaces. The pads are placed in parallel and the sampler was operated at flow rate of 11 m^3/hr/pad.

Since most air sampling is done with the Hi-Vol (JUTZE and FOSTER 1967), which is designed for particulate sampling, a stand was constructed to hold the air intake of the ERCO sampler at the same height (110 cm) from the ground as that of a standard Hi-Vol. The sampler was placed approximately one m downwind from the plots. Electrical power was supplied by a gasoline generator placed at a distance of 160 m from the samplers so that the exhaust fumes would not be drawn into the air sampler. Each individual tobacco plot was eight rows wide and 22.9 m long. Only the middle four rows were sprayed which provided untreated rows between the treated ones. The samplers were placed at the end of the middle two treated rows.

Weather data were collected during the sampling period. Temperature and rainfall data were taken on site, whereas the humidity data is from a U.S. Weather Service site approximately 32 km away.

After collection, the filter pads were returned to the laboratory and stored at -17°C until time of extraction. Each pad was Soxhlet-extracted with ethyl acetate for 4 hr at a rate of 5 cycles/hr. The extract was concentrated for gas chromatographic analysis without additional cleanup.

The G.C. parameters were: FPD detector, temperature 205°C; Column - 6.4-mmx183-cm glass packed with 4% SE-30 and 6% OV-210 on Gas Chrom® Q (60-80 mesh), temperature 200°C; Carrier gas-100 cc/min of N_2; injection port temperature 230°C.

Extraction efficiency was determined by fortifying filter pads with methyl parathion in hexane prior to extraction. The ERCO sampler had been modified so that a glass fiber filter could be placed upstream from the filter pad, thereby simplifying the task of establishing collection efficiencies. The collection efficiency of the filter pad was determined by fortifying the

glass fiber filter and operating the sampler for two hr. The sampler was never operated for more than two hours in the field.

The filter collection efficiency was determined to be 105% (4 samples) and the extraction efficiency was 92% (3 samples). The data was not corrected.

RESULTS AND DISCUSSION

The minimum temperature during the experimental period averaged 21°C (range: 18-24°C) and the maximum averaged 32°C (range: 28-34°C). The average relative humidity was 72% (range: 66-81%). Rain fell on day 6 (10 mm) and day 8 (13 mm). The weather was typical for this period in tobacco growing areas of North Carolina--hot, humid, and with little rainfall to wash pesticide residue from the foliage.

Air samples were taken at 0, 1, 3, 6 and 9 days post spraying. The sampling period employed was either one or two hrs., depending on the number of days post treatment. Sampling was conducted during the morning hours whenever possible. Each filter pad was analyzed separately and the results were averaged. On day 6, two samples were taken simultaneously at each plot.

The results are presented in Table 1. On day 0, the air concentration of methyl parathion near the ENCAP-treated field was found to be about half that near the EC-treated field. By day 1 it had dropped to about one-tenth that of the EC treatment. Air concentrations remained higher near the EC-treated field for up to six days. By day 9 the air concentrations near both fields were essentially the same. It is quite possible that the level reached by day 9 was the background level in the air around heavily treated areas.

TABLE 1

Methyl Parathion (ng/m^3)
in the Air Near Treated Fields

	Formulation	
DAY	EC	ENCAP
0	7400	3800
1	3300	330
3	580	110
6	36	25
	54	19
9	13	16

LEIDY et al. (1977) have demonstrated that ENCAP formulations of organophosphorus pesticides can provide extended protection of the crops against pests. These results readily demonstrate that they will also reduce the extent of contamination of the atmosphere by inhibiting vaporization of the pesticides from the foliage.

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